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Global Hawk In-flight turbulence Sensor

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Instrument Overview

Table 1. GHIS Specifications

Weight	6.5 lb
Dimensions	9" x 7.3" x 6.2"(H)
Data Rate	1 Hz, 10 Hz
Power requirements (avg) (max)	28 V, 0.5 A (< 15 W) 28 V, 1.5 A (42 W)
Operating Temperature	75°C maximum
Consumables	None

The NOAA Global Hawk In-flight turbulence Sensor (GHIS) is an autonomous instrument that can be placed at various GH instrument locations to detect 2-axis local accelerations (the instrument is normally placed such that one axis is horizontal and the other one is vertical; both are perpendicular to the line of flight) caused by turbulence and local vibrations. The GHIS instrument may also be reprogrammed to test command, control, and communication (C3) links. The instrument will broadcast the User (10 Hz) and Status (1 Hz) UDP packets with parameters of local acceleration as well as the local air temperature and pressure at the instrument location and the voltage of the aircraft DC power. The entire dataset is also stored on the instrument as CSV text files. The GHIS specifications are given in Table 1.

Instrument description

The GHIS instrument is designed to measure acceleration at the location of the instrument. Two accelerometers (2g and 5g full scale) are used on each of two measurement axes. The GHIS accelerometers are from the Model 1221 family manufactured by Silicon Designs, Inc. (http://www.silicondesigns.com/refmats.html) with a frequency response of 400-600Hz. The data system samples each sensor output at 1000 Hz and processes these data to produce mean, maximum, and root-mean square (RMS) values at 10 Hz. The processed data are then broadcast on the GH internet and brought to the ground via Status and User UDP packets. The accelerometers are calibrated by the manufacturer. We have validated the absolute calibration of the accelerometers in the NOAA lab.

Local temperature and pressure and the voltage of the aircraft DC power are also measured and broadcast by GHIS.

Construction and Operation

The GHIS Instrument (Figure 1) consists of a National Instrument CompactRIO (http://www.ni.com/compactrio/) data system and electronic systems for various sensors and power management. It requires aircraft 28VDC power and communicates via

Ethernet. The instrument connects to an EIP using an existing cable. The overall weight is 6.5 lb including the power cable. The structural bottom plate, 1/8" thick, is made of 2024 aluminum with a footprint of 9" x 7-1/4". Four through holes for 10-32 screws are placed in a 6-1/4" square pattern and can be used for mounting.

The instrument should be mounted such that the acceleration detection axes are oriented in the desired acceleration detection directions. The instrument should be mounted on a stiff foundation to minimize the interference of local vibrations.

The instrument runs autonomously and can be turned on and off at anytime. A green LED next to the fuse blinks at 1-s intervals when the data system is working normally. Except during the computer boot-up time, a non-blinking LED indicates a system failure.

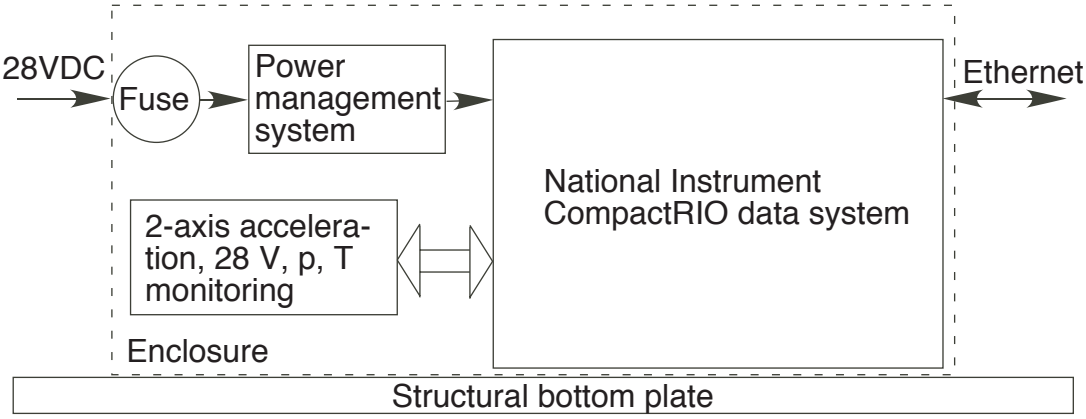

Figure 1. Block diagram for the GHIS.

Structure and Safety

The dominant mechanical and electrical load of the instrument is the National Instrument data system (Model CompactRIO). The data system has flown extensively onboard the NASA Global Hawk high altitude research aircraft at Zone 12, 16 (pressurized), and 61 (unpressurized).

The data system (3.4 lb) and the enclosure (0.9 lb) are attached to the bottom plate with two 10-32 and five 6-32 aircraft screws, respectively. The safety factor is over 100 for a 9-g landing. All screws on the instrument are secured with nutplates, locking Helicoils, locking nuts, or Loctite. All components except a temperature sensor for sensing the payload-bay temperature are confined in a 9" x 6" x 5" aluminum enclosure. There are no moving parts.

No shock mounts should be used for instrument installation.

A 1.5-A fuse limits input 28V power to 42 W. There is no heater inside the simulator. A thermostat limits operation to temperatures less than 75°C. The data system has a small battery for timekeeping (Model number M4T32-BR12SH). The simulator does not have static discharges and does not emit EMI or RFI.

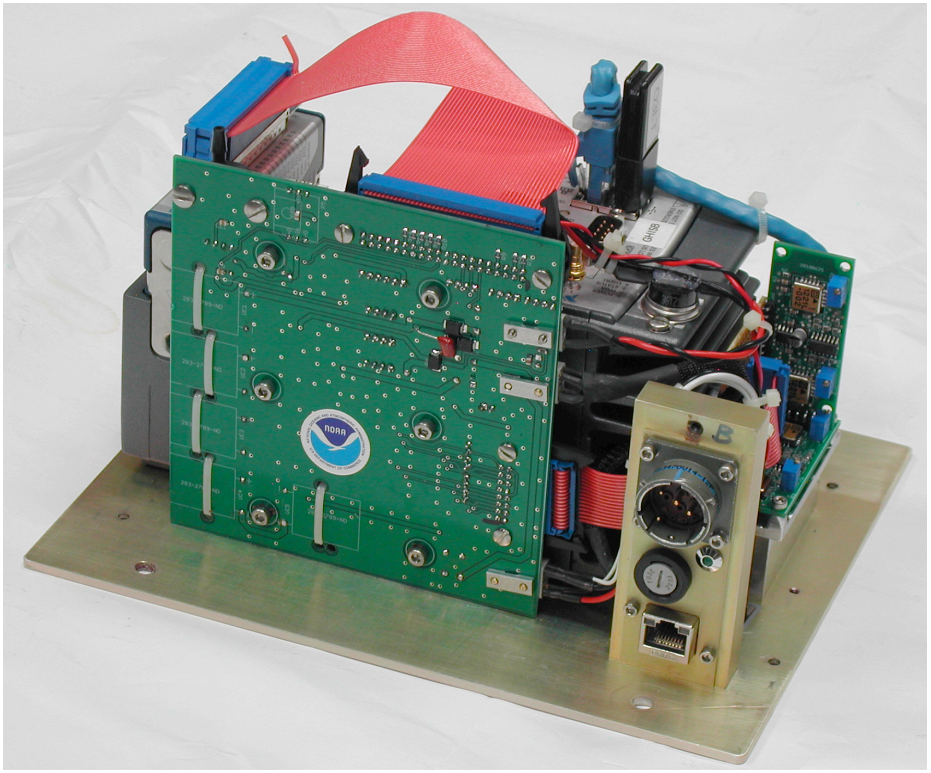

Figure 2. Inside view of GHIS.

Figure 3. Outside view of GHIS.